

The Canadian Entomologist

LXX.

ORILLIA, SEPTEMBER, 1938

No. 9

CASE-BUILDING IN TRICHOPTERA AS AN INHERITED RESPONSE TO OXYGEN DEFICIENCY.

BY MARGERY J. MILNE,

Randolph-Macon Woman's College, Lynchburg, Va.

Many papers have been written about caddis cases, treating these movable shelters from the standpoints of choice of materials (Brues 1930, Dodds & Hisaw 1926, Lloyd 1915, Lutz 1930, Simpson 1903), of repair (Marshall & Vorhies 1905), of ontogenetic initiation (Murphy 1919, Copeland & Crowell 1937), and of phylogenetic origin (Milne & Milne, 1938). The last of these references, a paper by Sleight (1913) and the work of Dodds & Hisaw cited above, give some attention to the relation between case-building and the physiology of the larva inhabiting the structure, but much remains to be studied in this connection.

The protective value of the caddis case has been much stressed. Since larvae in ponds and slow streams are the chief case-bearers, it might be suspected that a number of other features of their environment might conceivably be made more livable by the case-building habit. One such definite advantage which has received little attention is evident from observation of many limnephilid larvae in aquaria. When deprived of their cases, they struggle helplessly at the water surface, but once encased again, they are able to regulate their position in the dish with ease. In many species, buoyancy is given to the case by gas bubbles liberated or entrapped within it. This must aid in locomotion by supporting the abdomen, and quite compensate for the clumsiness of the case. In some species, the larvae are frequently noticed to suddenly release their hold on the bottom and rise, case and all, to the surface. This seems to be entirely due to the gas bubbles inside the case. The purpose of this migration has not yet been explained.

The air bubbles may have another value, so far unmentioned for Trichoptera. Ege (1915) and Wigglesworth (1931) have pointed out that the invasion co-efficient of oxygen from water to air is more than thrice that of nitrogen. Thus if the tension of oxygen in the water be higher than the partial pressure of oxygen in the air bubbles, there will be a greater tendency for equilibrium to be restored by the diffusion of oxygen into the bubble than by the diffusion of nitrogen out of it. Thus the nitrogen in the gas bubble makes invasion of an air store by oxygen possible, and it has been demonstrated that bubble-carrying insects in water saturated in oxygen but lacking nitrogen can survive only a tenth as long as those in water saturated with air, and only a seventieth as long in water saturated with nitrogen but lacking oxygen. But the nitrogen store gradually dissolves into the water and the bubble diminishes in size. It is to replenish this nitrogen store rather than to get oxygen directly that many insects now come to the surface for air. Is this the reason for the caddis worms freeing themselves from the bottom and rising to the surface? If so, the case would

be said to have the function of holding an air store for the larva, enabling it to use this bubble in one more way.

Obviously, the deeper the water on the bottom of which the larva is feeding, the farther it must go to get such air stores replenished. It would be very interesting to know if any such habits are shown by the larvae of *Phryganea sayi* Milne which Neave (1933) found to depths of twenty meters in Lake Winnipeg, Manitoba. Such a habitat is commonly regarded as only invaded by one type of insect, the midge larvae of Chironomidae, which seemingly can exist in almost anaerobic conditions. The finding of living *Phryganea* larvae at the surface of the lake over such deep areas would be good evidence for their vertical migration for air.

It might be noted that *Triaenodes* of Leptoceridae and the several genera of Phryganeidae build plant fiber cases on an elongate spiral plan, and that these caddis worms are able to swim with their cases, often rising vertically through the water, an unusual habit in Trichoptera. Although this swimming may be of use to the *Phryganea* found deep in Lake Winnipeg, it is not likely to have any bearing on *Molanna flavicornis* Bks. which is found at similar depths in the same lake, nearer shore, but makes a stone case unsuited for such active movement.

Probably the most important advantage which the case provides, however, is in increasing the availability of respiratory water. Compare a larva stationary on the bottom of a quiet pond waving its abdomen in the customary way, with a similarly undulating larva in a case, also stationary on the bottom nearby. It will be noted at once that the former caddis worm is churning up water only in its very immediate vicinity, while the latter is systematically forcing a current of water out of the posterior end of its case, to be replaced by different water from in front. The oxygen and carbon dioxide gradients around the first larva will be in the form of increasingly perfect concentric hemispheres as one measures away from it, until at a few times the larva's length, the only gas exchange will be by diffusion. In the second instance, it is doubtful if any of the water pushed out of the case re-enters it within the same hour and a circulation for a considerable distance from the case is maintained. The gas gradients here would be very complex.

A subsidiary advantage to the respiratory one is the increase in food availability. The naked larva must move around in order to gain access to more of its food supply. The cased larva is constantly bringing the planktonic portion of its environment past its mouthparts by circulating the water with its undulating abdomen, thus duplicating in an independent way the feeding conditions found in a stream.

It would appear that the function of the case has been underestimated, chiefly by the appeal to the human mind of the anthropomorphic suggestion of a "house." This notion of the protective value of the case has been so stressed that the other uses have been overlooked. Further evidence that the factor of protection is relatively unimportant might be drawn from the fact that while caseless larvae are more exposed, they are usually not more sclerotized but less. This fact may, of course, be interpreted equally well as reason for disbelief in the

similarly satisfying explanations that the sclerites are "armor" for protection, or a "framework" for muscle attachment, since the exceedingly active, caseless rhyacophilids have the fewest, weakest plates of the whole order.

Thus the protective aspect of caddis cases is probably an insignificant factor in the series of physiological needs which led ancestral Trichoptera to the case-building habit. In the light of the considerations outlined above, the response to oxygen deficiency is a more reasonable explanation of the value of cases to caddis worms.

Note.—Since writing the above article, two larvae of *Phryganea sayi* Milne have been forwarded to me for identification from Lake Manitoba, the smaller lake west of Lake Winnipeg. These specimens were samples of what fishermen there call "floatworms," because the larvae make themselves at home in the floats which support the fishing nets. In this niche they do considerable damage by severing the sideline passing through the tubular cedar float so that the net is detached and the float lost. This loss is always between January first and the breakup of the ice in the spring and bears no relation to depth, type of bottom, or distance from shore. When a number of floats are liberated from a single net, the net sinks and is lost too.

Mr. Donald N. Smith of Winnipeg, Man. became interested in this problem and ascertained the following concerning the economic aspects.—

More than 900 fishing licenses have been issued for Lake Manitoba, each license denoting about 100 nets in use. Each net is supported by about 40 floats, each tubular, of cedar, with a one half inch bore, weighing about an ounce and costing two cents apiece. Nets may lose as many as 13 floats without loss of the net itself, but the average float loss according to Mr. Thomas Cook, who has fished the lake for the last 15 years, is about 5% of the floats used. This amounts to about \$3,600 for floats alone lost each winter, and an unestimated amount for nets. Nets cost \$5.00 each.

The larvae are invariably found in the bore of the floats, and the incidence is the same in untarred floats as in those treated to prevent rotting and water logging. The ice through which the nets are set varies from two and one fourth to four feet in thickness. The larvae are found from one fourth to fifteen miles from shore, in water from six to twenty-two feet in depth. Larvae are rare over hard bottom, but common over soft. Neave found *Phryganea* larvae in soft bottom more than in hard and attributed his results to the type of dredge used in sampling.

These data on the behavior of *Phryganea sayi* might be taken as evidencing their vertical migration for air. During the period of the year when the water is frozen over, they might be expected to concentrate in air holes such as are cut for the nets and perhaps to remain at or near the surface while the bottom water becomes increasingly stagnant and oxygen-poor. Their attack on the net sidelines may be a feeding reaction or an attempt to cut case material. More information is needed regarding this interesting habit.

LITERATURE CITED

- Brues, C. T. 1930, "Jewelled caddis-worm cases." *Psyche* 37 (4) 392-394.
Copeland, M. & P. S. Crowell 1937, "Observations and experiments on the case-building instincts of two species of Trichoptera," *Psyche* 64 (4): 125-131.

- Dodds, G. S. & F. L. Hisaw 1926, "Ecological studies on aquatic insects," Ecology 6 (2): 380-390.
- Ege, R. 1915, "On the respiratory function of the air stores carried by some aquatic insects," Zeitschr. f. allg. Physiol. 17: 81-124.
- Lloyd, J. T. 1915, "Wood-boring Trichoptera," Psyche 22: 17-21.
- Lutz, F. E. 1930, "Caddis fly larvae as masons and builders," Nat. Hist. 30: 276-281.
- 1932 "Our ignorance concerning insects," Can. Ent. 64: 73-78.
- Marshall, W. S. & C. T. Vorhies 1905, "The repair and rebuilding of the larval cases of *Platyphylax designatus* Wlk.," Biol. Bull. 9: 232-244.
- Milne, M. J. & L. J. Milne 1938, "Evolutionary trends in caddis worm case construction", in press.
- Murphy, H. E. 1919, "Observations on the egg laying of the caddis fly, *Brachycentrus nigrisoma* Bks.," Journ. N. Y. Ent. Soc. 27: 154-159.
- Neave, Ferris 1933, "Ecology of two species of Trichoptera in Lake Winnipeg", Internat. Rev. Hydrob. u. Hydrog. 29 (1-2) : 17-28.
- Simpson, E. B. 1903, "The log-cabin builder," Proc. Ent. Soc. Wash. 5: 98-100.
- Sleight, C. E. 1913, "Relations of Trichoptera to their environment," Journ. N. Y. Ent. Soc. 21 : 4-8.
- Wigglesworth, V. B. 1931, "The respiration of insects," Biol. Rev. & Biol. Proc. Camb. Phil. Soc. 6 (2) : 181-220.

A CONTRIBUTION TO A LIST OF THE APHIDIDAE OF THE MARITIME PROVINCES OF CANADA.

BY JEAN C. BURNHAM,

Dominion Entomological Laboratory, Fredericton, N.B.

There has been to date, to the knowledge of the writer, no published list of the species of Aphididae common to the Maritime Provinces of Canada. It is proposed in the following contribution to make a beginning to such a list, with the hope that it may prove useful to interested taxonomists.

The material from which information for the list was obtained has been collected over a period of some four years, between 1934 and 1937, and slides of the various species are filed at the Dominion Entomological Laboratory in Fredericton, N.B. When doubt as to the certainty of various identifications arose, a number of the slides were submitted to Dr. Edith M. Patch at the Maine State Experiment Station, whose kind aid we gratefully acknowledge.

ALPHABETICAL LIST OF SPECIES

abbreviata Patch (*Aphis*); [*rhamni* Boyer (*Aphis*)]—Collected on *Rhamnus cathartica* L., its primary host, on June 16, 1936, and similar dates for other years; on *Solanum tuberosum* L. throughout the summer season at various localities throughout New Brunswick.

This aphid may be found on the lower leaves of potato throughout New Brunswick in suitable seasons. It has been commonly found in Carleton and York counties. Occasionally collected on weeds such as *Chenopodium album* L. and *Capsella bursa-pastoris* (L.) Medicus in potato fields. It has also been taken from *Tropaeolum majus* L. on August 7, 1936.

This species, under the synonym *Aphis rhamni* Boyer, was demonstrated as early as 1925 to play a part in the transmission of so-called potato mosaic (Schultz and Folsom, 1935).

abietinus Koch (*Mindarus*)—This species has been collected from *Picea rubra* (Du Roi) Dietr., on July 13, 1934; also collected from galls on *Rhus hirta* Sud. in 1936.

acerifoliae Thomas (*Drepanaphis*)—An alate form of this species was collect-

ed on *Daucus rubra* L. In all likelihood it is an errant, merely resting on this host. The collection was made on October 5, 1936. The dorsal tubercles, trumpet-shaped cornicles and long, hair-like antennal flagella are very noticeable.

aegopodii Scopoli (*Cavariella*); (*pastinacea* Davis)—This species was taken from *Salix* sp., *Amphicarpa* sp., *Daucus carota* L., on July 9, 1934.

agilis Kalt. (*Eulachnus*)—This aphid was taken from *Picea rubra* (Du Roi) Dietr. at the same time as the collection of *abietinus* was made. It agrees with Gillette and Palmer's description except for sensorial number on segment III of the antennae, and the fact that in the mounted material the body does not appear abnormally narrow or elongate. There is only a slight indication of a once-branched media in our specimens, and antennal III shows no sensoria. Until proven to be some other species the name *agilis* will be retained.

albifrons Essig (*Macrosiphum*)—This large aphid was collected in numbers from stalks of *Lupinus* sp. at the Experimental Station and in the garden of R. P. Gorham, Fredericton, N.B., on June 24, 1936. This species is covered with a greyish powder in the natural state.

americanus Baker (*Periphyllus*)—This species was taken from *Crataegus* sp. on June 17, 1937. Resembles what is identified as *P. populicola* Thomas, by Hottes and Frison. Sensorial number does not check, however, so *americanus* preferred according to Patch, "Hemiptera of Connecticut," page 285.

asclepiadis Fitch (*Aphis*)—This aphid was taken with a collection of *Macrosiphum solanifolii* Ashmead, on ragweed (*Ambrosia* sp.) at Rustico, Prince Edward Island, on August 18, 1937. The specimen agrees with *asclepiadis* as described and keyed by Hottes and Frison in "Plant-Lice of Illinois," but the arrangement and number of sensoria on antennal segment III does not agree with that as given for supposedly synonymous species.

atriplicis Linnaeus (*Hyalopectus*)—Taken from *Chenopodium album* Linnaeus on August 8, 1934. This aphid has been reported by Zaumeyer in 1933, as a carrier of the virus of bean mosaic.

attenuatus Osborn and Serrine (*Neoprociphilus*)—An errant form collected on the University of New Brunswick campus, Fredericton, N.B., on August 16, 1936, was identified as this species. Miss Patch (1912) has described and figured this form well and our specimen seems to agree in detail with her descriptions. Cornicles are not noticeable, and the wing venation is typical of the newly erected genus.

berberidis Kaltenbach (*Liosomaphis*) [*Rhopalosiphum*]—This small aphid was found in abundance on the lower surfaces of the leaves of *Berberis vulgaris* Linnaeus on September 10, 1936. It was also taken the previous spring. Collections from some weeds were made during the summer. Among these were *Daucus carota* Linnaeus and upon it were found a number of aphids of this species. This collection was made on August 6, 1936.

betulae Kaltenbach (*Eucraphis*)—A solitary specimen identified as this species was taken in a collection of *Eulachnus agilis* Kaltenbach, on July 4, 1934, near Fredericton, N.B., on *Picea canadensis* (Mill.) B.S.P. Also a specimen from *Betula lutea* Michx. f. on June 6, 1935.

betulaecolens Fitch (*Calaphis*)—This species was taken on *Betula lutea* Michx. on September 18, 1936, on the campus at the University of New Brunswick, Fredericton.

brassicae Linnaeus (*Brevicoryne*)—Collections of aphids from *Hedera helix* L. and *Brassica rapa* Linnaeus, have shown this aphid to be present on these plants. Collections were made on April 29, 1936, from *H. helix* L. In 1930, this species was shown by F. E. Clayton to be the vector of the virus disease, mosaic of crucifers.

brevispinosa Gillette and Palmer (*Cinara*)—This specimen was received for identification from the Division of Forest Insects. It was taken from Jack pine (*Pinus banksiana* Lamb.) on June 17, 1937.

capreae Fabricius (*Cavariella*)—This collection was taken from *Daucus carota* Linnaeus, on the roadside at Victoria, N.B. The collection was found to be a mixed one, containing both this species and *Liosomaphis berberidis* Kaltenbach, and was made on June 17, 1937.

cerasi Fabricius (*Myzus*)—These specimens were taken at Springhill, N.B., from *Prunus virginiana* Linnaeus, on September 23, 1936.

cerasifoliae Fitch (*Aphis*)—Specimens were collected from *Prunus virginiana* Linnaeus on May 29, 1937. These collections were made from the hedgerow, University Field, Fredericton, N.B.

cornelli Patch (*Macrosiphum*)—This identification has been given to an aphid collected from *Hieracium* sp. (hawkweed) on August 13, 1936; although the description and illustrations of *Macrosiphum pelargonii* Kaltenbach as given by Gillette and Palmer agree with the characteristics of this specimen, this is not the case with Theobald's description. The difference appears in the number of antennal sensoria present on segment III; since Gillette and Palmer mention this in regard to *Macrosiphum cornelli* Patch, the specimen has been placed here. The resemblance to *pelargonii* Kaltenbach is, however, very striking. These specimens were collected at Richmond, P.E.I.

coryli Davis? (*Macrosiphum*)—No definite statement will be made at this time regarding this species. Specimens taken from *Corylus* sp. are certainly *Macrosiphum* but no description of the species, *coryli* is available. Until such literature or slides of *coryli* Davis be obtained this aphid is tentatively identified as this species collected on June 17, 1937, in Florenceville, N.B.

cosmopolitanus Mason (*Amphorophora*)—Taken on *Ribes vulgare* Lam., on June 4, 1936. Common in New Brunswick.

dirhodum Walker (*Macrosiphum*)—This has been taken from alfalfa (*Medicago sativa* Linnaeus) and from caragana on August 6, 1936, at O'Leary, P. E. I.

flocculosa Weed (*Plocamaphis*)—These specimens were submitted through the kindness of F. M. Cannon, from Charlottetown, P.E.I. They were collected from *Salix* sp. on June 16, 1937.

fragaefolii Cockerell (*Capitophorus*); (*potentillae* Walker *Capitophorus*)—Authorities believe these names to be synonymous. These specimens were found on *Fragaria* sp. at the Experimental Station, Fredericton, N.B.; collections were made on May 22, 1935. In 1926 this species was named by A. G. Plakidas as the vector of "strawberry yellows."

frigidae Oestlund (*Macrosiphum*)—This species was taken from *Artemisia* sp. on August 6, 1934.

frigidicola Gillette and Palmer (*Macrosiphum*)—This species was collected from *Artemisia* sp. on August 18, 1937. The cornicles are rather short for the genus *Macrosiphum* and are reticulated over one half their lengths; the basal portion in some specimens shows a slight swelling; the apterae are characterized by the presence of three sensoria at the slightly enlarged base of antennal segment III. Bluish in colour and difficult to see when feeding on its host.

genistae Scopoli (*Aphis*)—This species is very closely related to *medicaginis* Koch, according to key characteristics. The material which we have, has been identified as *genistae* Scopoli, due to its short cornicles. Otherwise the description given by Gillette and Palmer apparently fits this species (*medicaginis*). This collection was made from *Lactuca canadensis* Linnaeus at Richmond, P.E.I., on August 13, 1936.

gossypii Glover (*Aphis*)—This species was collected from *Sedum purpureum* Linnaeus on August 2, 1934, near Fredericton, N.B. In 1928, Doolittle incriminated this species in the transmission of cucumber mosaic.

granarium Kirby (*Macrosiphum*)—This common grain aphid was taken from *Graminis tritici* L. on August 6, 1936, at O'Leary, P.E.I., and on *Avena sativa* L. at Charlottetown, P.E.I., July 9, 1936. Collections have also been made at Fredericton, N. B.

helianthi Monell (*Aphis*)—This aphid was found on *Cornus* sp. and originally identified as *Aphis cornifoliae* Fitch. More careful study, however, revealed slight discrepancies in the key characters. The number of sensoria on antennal segment III would indicate *helianthi*. The collection was made on June 23, 1934.

helichrysi Theobald (*Anuraphis*)—This species presents a classic example of the problem in aphid synonymy. It is taken from *Prunus* sp. in a collection made at Fredericton in early October, 1936. This collection also contained specimens of *Myzus persicae* Sulzer.

horridus Theobald (*Periphyllus*)—This identification is given with reservations. The alatae which are present on our slide are certainly of the genus *Periphyllus* but the species is in question. The cornicle agrees remarkably with that described by Theobald for the apterous form of *horridus* but no alate form is mentioned. This collection was made from Carolina poplar (*Populus* sp.) on July 19, 1934, at the Dominion Experimental Station, Fredericton, N.B.

humuli Schrank (*Phorodon*)—One collection of this species has been taken from *Humulus lupulus* Linnaeus at New Perth on July 10, 1936. The available specimens are not well preserved but the typical *Phorodon* projections on the frontal tubercles of the apterae are well marked.

lanigera Hausmann (*Eriosoma*)—This aphid was present in great numbers on June 19, 1936, on the leaves of *Ulmus* sp., bordering the streets in Fredericton, N.B.

lyropictus Kessler (*Periphyllus*)—This species was taken at Fredericton from *Acer* sp. in August, 1936; collection was made by members of the Division of Forest Insects.

maidis Fitch (*Aphis*)—Taken from *Agrimonia* sp. on October 5, 1936, near

Fredericton, N.B. In 1920, E. W. Brandes showed this species to be the one carrying the virus of sugar-cane mosaic.

media Baker (*Pterocomma*)—This species was very abundant on *Populus* sp. at Red Rapids, N.B., in June, 1937. It is very similar in structure to *Pterocomma beulahensis* Cockerell. It is also very closely identified with *Clavigerus smithiae* Monell, differing only in the thickness of the cornicles.

middletonii Thomas (*Aphis*)—The specimens identified as this species were collected from *Cornus* sp. on October 5, 1936, on the campus of the University of New Brunswick of Fredericton.

monardae Oestlund (*Aphis*)—The identification of this species has been based entirely upon descriptions by Gillette and Palmer. The presence of pronounced lateral tubercles set it apart from other commoner species of the genus *Aphis*. These are well developed on abdominal segments one and six or seven. It is a comparatively large species that has been collected in New Brunswick on *Arctium minus* Bernh., on October 5, 1936.

monelli Davis (*Drepanosiphum*)—Taken from "Scotch" rose (*Rosa* sp.) on the East Baltic Road, N.B., on July 10, 1936.

nabali Oestlund (*Amphorophora*)—Collected from common ragweed, *Ambrosia* sp., on July 27, 1934, near Fredericton, N.B.

neglectus Hottes and Frison (*Chaitophorus*)—From *Populus* sp. at Florenceville, N.B., on June 17, 1937. It is a markedly flocculent species.

negundinis Thomas (*Periphyllus*)—Specimens were collected from Manitoba maple (*Acer* sp.) near Charlottetown, P.E.I., on June 16, 1937.

olivacea Rohwer (*Forda*)—Specimens identified as this species have been taken from the roots of *Erigeron* sp. on June 15, 1937. This species is characterized by its antennal structure, being only five-segmented in both alatae and apterae (see Gillette and Palmer, Annals of the Entomological Society of America, Volume XXVII: 238). Only the apterous forms have been studied by the writer.

persicae Sulzer (*Myzus*)—This has been one of the most abundant species found in New Brunswick and has been taken in quantity throughout Carleton and Victoria counties in the western part of the province. Since 1934 it has been found yearly on *Solanum tuberosum* Linnaeus throughout the summer months and also on the sprouts in winter storage. Following are additional hosts upon which this species has been taken: winter hosts; *Prunus pennsylvanica* Linnaeus and *Prunus virginiana* Linnaeus; as secondary hosts, *Tropaeolum majus* L., *Chenopodium album* Linnaeus, *Brassica campestris* Linnaeus, *Dahlia* sp., *Brassica rapa* Linnaeus, and others. This aphid is a very common greenhouse pest. In 1914, Allard mentioned this aphid as the vector of tobacco mosaic. This was apparently the first mention of this group of insects in their role as disease carriers. In 1918, Hoggan insisted that it was cucumber mosaic that was being transmitted. Since that time it has been shown that of all aphid species this one is the most efficient disease vector, being incriminated in the transmission of over forty virus diseases..

persicae-niger Smith (*Anuraphis*)—Taken from *Prunus nigra* Linnaeus, Fredericton, N.B., on September 14, 1936.

pinicola Kaltenbach (*Cinara*) [*Eulachnus*].—This species was found on *Picea rubra* (Du Roi) Dietr. on June 13, 1934.

pisi Kaltenbach (*Macrosiphum*).—Found in abundance infesting garden peas (*Pisum sativum* L.) at O'Leary, P.E.I., and at St. Marys, N.B., in August, 1936. In 1922, Dickson incriminated this species in the transmission of pea mosaic.

pomi DeGeer (*Aphis*).—This species was taken on *Pyrus malus* Linnaeus on July 10, 1934.

populi Linnaeus (*Chaitophorus*).—A mixed collection of this species and *Cavariella theobaldi* G. has been received but no host name appended. The collection was made at Florenceville, N.B., on June 17, 1937.

populicola Thomas (*Periphyllus*).—Collected from *Populus tremuloides* Michx. on July 27, 1934. On one of the slides there appears to be present a distinct variety of *populicola*. It is noted by its extremely under-developed cornicles and excessive number of sensoria on III, IV and V.

potentillae Walker (*Capitophorus*).—This species has been collected from wild rose upon two different occasions. No attempt has been made to straighten out the mixed-up synonymy in which this species has been concerned. It seems sufficient that the specimens obtained ably fit Gillette and Palmer's description of *potentillae* Walker, (Annals Ent. Soc. of Amer., Vol. 27: 153). Collections were made on May 22, 1935, and on June 10, 1935. As *Myzus fragaefolii* Cockerell, this species was indicated as the vector of "strawberry yellows" in 1926 by A. G. Plakidas; and as *potentillae* as the vector of "yellow edge" by Chamberlain in 1934.

pseudosolani Theobald (*Myzus*).—Taken in several cases from *Solanum tuberosum* Linnaeus in various parts of New Brunswick and from *Rheum* sp. at Richard, P.E.I. on August 8, 1936. In New Brunswick, it has been found in apparently declining abundance on *Solanum tuberosum* Linnaeus. In 1926 this species was incriminated in the transmission of potato viruses by Murphy and McKay.

rhois Fitch (*Melaphis*).—From galls on the leaves of *Rhus* sp. near Fredericton, N.B., on October 14, 1936. This is the common species forming galls on sumach.

ribis Linnaeus (*Capitophorus*).—Taken from *Persicaria persicaria* L. at Rustico, P. E. I.

rosarum Kaltenbach (*Capitophorus*).—This species as described by Theobald (1926) is the *Capitophorus fragaefolii* Cockerell of Hottes and Frison. It was taken from *Rosa nitida* Linnaeus near Centreville, N.B.

rossi Hottes and Frison (*Amphorophora*).—This collection has been identified as *rossi* due to its swollen cornicles and sensoria present only on antennal III, averaging about 25 in number. Unfortunately, only one alate form was present on the slide and this one was not well-spread so that structural characters were difficult to determine. This specimen was collected from *Carum* sp. on June 17, 1937. Drake et al, stated that this species had been able to transmit the virus causing onion dwarf (1935).

rubi Kaltenbach (*Amphorophora*).—This species was collected from *Rubus*

sp. on June 7, 1935. In 1927, Blathny showed this insect to be the carrier of the viruses causing certain raspberry and blackberry diseases.

rubicola Oestlund (*Amphorophora*)—Taken from *Rubus occidentalis* Linnaeus on August 6, 1936, at Fredericton, N.B. Also taken from *Crataegus* sp. at Charlottetown, P.E.I., on June 28, 1937.

rubifolium Theobald (*Macrosiphum*)—An errant species, taken in flight on the University of New Brunswick campus, Fredericton, N.B., in August, 1936. The description is given in Theobald's *British Aphides*—Book 1: 77. There is no mention of it found in the available American references. Possibly a variety of "rosae"?

rudbeckiae Fitch (*Macrosiphum*)—This large vermilion aphid is found in abundance during some seasons infesting the stems of goldenrod, *Solidago* sp.; this collection was made on July 6, 1934, at Fredericton.

rumicis Linnaeus (*Aphis*)—This aphid has been common in New Brunswick and Prince Edward Island and has been taken from the following hosts: Hollyhock (*Althaea rosae* Ca.), August 7, 1936; *Hieracium* sp., August 6, 1936; *Dahlia* sp., August 7, 1936; *Dahlia* sp., August 13, 1936; and at the following localities: Charlottetown, P.E.I.; Richmond, P.E.I., Fredericton, N.B. In 1918, McClintock and Smith incriminated this aphid in the transmission of spinach blight.

sanborni Patch (*Aphis*)—These specimens were taken in flight so their host plants are unknown. The specimens closely resemble the description given by Patch of her *Aphis sanborni*. It is certainly a true *Aphis* form with typical cornicles, wings, and lack of development in the antennal tubercles. The collection was made in June, 1937.

schranksi Theobald (*Macrosiphum*)—This species was taken on *Convolvulus* sp. at Charlottetown, P.E.I., on July 9, 1936.

solanifolii Ashmead (*Macrosiphum*)—With no exception this aphid has been the most commonly collected in New Brunswick. It has been taken from a horde of different hosts, among which have been *Solanum tuberosum* Linnaeus, *Rosa rugosa* Linnaeus, *Rosa* sp., *Capsella bursa-pastoris* Linnaeus, *Spergula arvensis* Linnaeus, *Fragaria* sp., Soy bean (*Glycine soja* Sie. & Zucc.) *Zea Mays*, *Tropaeolum majus* L., and the majority of potato-field weeds. Species of *Rosa* have been found to be primary hosts and a wide variety of plants to be suitable secondary host. This species, under the synonym, *Macrosiphum tabaci* Pergande, was incriminated in the transmission of tobacco mosaic in 1917 by Allard. As *M. solanifolii* Ashmead it was mentioned in this regard by Schultz and Folsom in 1918.

spiraeicola Patch (*Aphis*)—This is an errant form taken on the University of New Brunswick campus, Fredericton, N.B., in August, 1936. It agrees with this species in all characters except size and our specimen is a trifle smaller than the Maine type specimens of the species.

squamosa Hartig (*Geioica*)—This collection was taken from the roots of greenhouse grown timothy at the Experiment Station, Fredericton, N.B. The collection was made on November 24, 1936.

strobilobius Kaltenbach (*Chermes*)—This aphid was the first species collected

out-of-doors in 1937, it was taken from the bursting buds of *Larix* sp. on the University forest land on April 17. All stages from egg, through immature to mature apterous forms, were taken. Alate specimens were collected in May.

taraxaci Kaltenbach (*Macrosiphum*)—This species was found on wild lettuce (*Lactuca canadensis* Linnaeus) at Richmond, Prince Edward Island, on August 13, 1936.

theobaldi Gillette (*Cavariella*)—This single apterous form was collected from Peony at Fredericton, N.B., on June 30, 1936. No alate forms are available and this identification is based entirely upon examination of one apterous female. The cornicles are cylindrical "and greatly curved outward." (See Gillette and Palmer, Annals of the Entomological Society of America, Volume 25: 468). After this identification, alatae were received from Florenceville, N.B., on June 17, 1937.

tiliae Linnaeus (*Therioaphis*) [*Myzocallis*]—This species was collected from *Tilia americana* Linnaeus on October 5, 1936, near Fredericton, N.B. The species may be easily recognized by the dusky markings on the wings, the slender form of the body, and the definitely bifid anal plate.

ulmi Linnaeus (*Eriosoma*)—Found curling the leaves of *Ulmus* sp. in Charlottetown, P.E.I., on June 28, 1937. It differs from *E. lanigera* Hausmann in its more numerous sensoria on antennal III and complete lack of secondary sensoria on antennal IV.

ulmi Wilson (*Georgiaphis*)—This aphid was found rolling the leaves of *Ulmus americana* Linnaeus in Fredericton, N.B., on August 22, 1934. There appears to be some complexity to the synonymy of this species, although the name as here indicated seems to be the one accepted at present. It is very closely identified with *Georgiaphis gillettii* M. and H. but Hottes and Frison tend to feel that the latter is only a variety of *ulmi*.

ulmifolii Monell (*Tuberculator*)—This species was taken from *Ulmus* sp. by members of the Division of Forest Insects near Fredericton on September 18, 1936.

viburnicola Gillette (*Aphis*)—Taken in one of the earliest collections made during the season of 1937. It was found on *Viburnum opulus* Linnaeus on May 31, 1937, at Fredericton, (see Hemiptera of Connecticut, page 297).

viminalis Monell (*Chaitophorus*)—From the study of some slide material, this species appears to be present on *Salix tristis* Aitland, June 17, 1937, Florenceville, N. B. A curious wing structure is present on one specimen. The primary branch of the media and the cubitus are connected by a simple cross vein. This condition is present on only one wing, the other being quite normal. The body hairs on our material are not very distinct.

LITERATURE CITED

- Allard, H. A., 1914—"The mosaic disease of tobacco." U.S. Dept. Agric. Bull. 40: 1-33.
 1917—"Further studies on the mosaic disease of tobacco." Journ. Agric. Res. 10.
 Blattny, Ctibor, 1927—"Oivirusovych charobach Malimicker a Ostrugimiku." Ochrana Rostlin 7: 3-4.
 Brandes, E. W. 1921—"Artificial and insect transmission of sugar cane mosaic." Jour. Agric. Res. 19 (3): 131-138.
 Chamberlain, E. E., 1934—"A virus disease of strawberries in New Zealand." New Zealand Journ. Agric. 49 (4): 226-231.
 Clayton, E. E., 1930—"A study of the mosaic disease of crucifers." Journ. Agric. Res. 40 (3).

- Dickson, B. T., 1922—"Studies concerning mosaic diseases." Macdonald College (Quebec) technical bulletin 2.
- Doolittle, S. P., 1928—"Aphid transmission of cucumber mosaic." Abstract in Phytopathology 18 (1).
- Drake et al., 1933—"The relationship of aphids to the transmission of yellow dwarf of onions." Journ. Econ. Ent. 26 (4): 841-846.
- Gillette & Palmer, 1934—"Aphidae of Colorado." (3 volumes). Annals Ent. Soc. Amer. v. 24, 25, 27.
- Hottes and Frisom, 1931—"Aphididae of Illinois." Bulletin of Natural History, Vol. xix, article iii.
- McClintock & Smith, 1918—"True nature of spinach blight and relation of insects to its transmission." Journ. Agric. Res. 14 (1): 1-59.
- Murphy & McKay, 1926—"Methods for investigating the virus diseases of the potato, and some results obtained by their use." Sc. Proc. Reval Dublin Society, 18 (14): 169-184.
- Patch, E.M., 1942—"Aphid pests of Maine." Me. Agric. Exp. Sta. Bulletin No. 202.
- 1923—"Hemiptera of Connecticut." (State Natural History Survey Bulletin).
- Plakidas, 1926—"Strawberry yellows; a degeneration disease of the strawberry." Phytopathology, 16 (6).
- Schultz & Folsom, 1925—"Infection and dissemination experiments with degeneration diseases of potatoes; observations in 1923." Journ. Agric. Res., 30 (6): 493-523.
- Theobald, F. V.—"Aphididae of Great Britain." Vol. 1, 1926, Vol. 2, 1927, Vol. 3, 1929.
- Zaunmeyer, W. J., 1933—"Transmission of bean mosaic by insects." Abstract from Phytopathology 25 (1): 40.

AN ANNOTATED LIST OF THE INSECT FAUNA OF DOUGLAS FIR (*PSEUDOTSUGA MUCRONATA RAFINESQUE*) IN THE NORTHERN ROCKY MOUNTAIN REGION.

BY W. D. BEDARD,

Bureau of Entomology and Plant Quarantine, Forest Insect Field Laboratory,
Coeur d'Alene, Idaho.

This list is a record of insects which have been found in or on Douglas fir in the northern Rocky Mountain region by personnel of the Forest Insect Field Laboratory at Coeur d'Alene, Idaho. It comprises insects which feed upon the tree, as well as the parasites and associates of these insects. Of the 153 species listed, 102 were collected by the writer while making a study of the Douglas fir beetle (*Dendroctonus pseudotsugae* Hopk.). The remainder are listed in the laboratory records and were collected by J. C. Evenden, R. E. Balch,¹ H. J. Rust, and D. DeLeon².

Most of the specimens were determined by specialists³ whose initials are shown in double parentheses following the name of the insects which they determined. Where no name appears the specimen was identified by comparison with previously identified material in the laboratory collection.

ORDER COLLEMBOLA

Family Entomobryidae

Entomobrya sp. ((J. W. F.)). This insect is common under the bark of trees attacked by the Douglas fir beetle, from the time the beetle reaches the adult stage in August until it emerges during May of the following year.

¹Balch, R. E. The fir tussock moth (*Hemerocampa pseudotsugata* McD.). Jour. Econ. Ent. 25: 6: 1143-1148, 1932.

²DeLeon, Donald An annotated list of the parasites, predators, and other associated fauna of the mountain pine beetle in western white pine and lodgepole pine. Canad. Ent. 66: 3: 51-61, 1934.

³J. M. Aldrich, H. G. Barber, H. S. Barber, M. W. Blackman, J. C. Bradley, H. E. Burke, August Busck, A. N. Caudell, E. A. Chapin, J. F. G. Clarke, F. C. Craighead, R. A. Cushman, W. S. Fisher, J. W. Folsom, A. B. Gahan, C. T. Greene, Carl Heinrich, William Middleton, C. F. W. Muesebeck, G. A. Sandhouse, Alan Stone, and L. H. Weld.

ORDER CORRODENTIA

Family Psocidae

Psocus maculosus (Banks) ((A.N.C.)). Adults of this insect were reared from bark infested with the Douglas fir beetle. Emergence occurred during July.

ORDER HOMOPTERA

Family Adelgidae

Adelges cooleyi (Gillette). This well-known bark louse feeds on the foliage of Douglas fir. Nonmigrant adults were collected during September.

ORDER HEMIPTERA

Family Aradidae

Aradus debilis Uhler. ((H.G.)). This insect is believed to feed on the larvae of the Douglas fir beetle, as well as other larvae beneath the bark. Adults were reared from bark during July.

A. proboscideus Walker ((H.G.B.)). Like the preceding species, this insect is believed to be a facultative predator. Adults were reared from bark during July.

ORDER NEUROPTERA

Family Chrysopidae

Chrysopa plorabunda Fitch ((A.N.C.)). Large groups of this insect were found during May and June beneath the bark of trees attacked by the Douglas fir beetle during the previous season. The large groups indicate that these trees were being used for winter hibernation.

ORDER LEPIDOPTERA

Family Olethreutidae

Barbara colfaxiana colfaxiana (Kearf.) ((C.H.)). The Douglas fir cone moth destroys a fairly large percentage of Douglas fir cones. Infested cones fall from the trees during midsummer and the moths emerge during the fall. In some cases it was found that the moths spent 2 years in the cones before emerging.

Family Tortricidae

Cacoecia fumiferana (Clem.) ((C.H.)). The spruce bud worm has killed many trees in the northern Rocky Mountain region by completely defoliating them. Epidemics of this insect are usually followed by epidemics of the Douglas fir beetle, which attacks and kills many additional trees.

Peronea variaria (Fernald) ((A.B.)). This insect is a defoliator associated with the spruce budworm. Adults were collected in August and females were observed ovipositing during September.

Family Geometridae

Eupithecia spermaphaga (Dyar). Reared from cones sent to Mr. J. M. Miller from Colorado. Collections in the Coeur d'Alene Laboratory record this insect from western white pine.

Nepytia canosaria (Walk.) ((J.F.G.C.)). Adults of this moth were reared from Douglas fir foliage infested with the Douglas fir tussock moth. Emergence occurred in August.

Family Oecophoridae

Epicallima coloradella (Wlsm.) ((A.B.)). This insect probably used the Douglas fir bark for hibernation purposes. Adults were reared from bark in

July.

Family Aegeriidae

Conopia novaroensis (Hy. Edw.).

Vespamina sequoiae (Hy. Edw.). These two aegeriids are Douglas fir pitch moth and cause the large pitch balls on the lower trunk of the tree. Larvae were collected from pitch masses throughout the season.

Family Pyralididae: Phycitinae

Dioryctria abietella (D. and S.). This insect was reared from cones collected in Montana and sent to J. M. Miller by J. Brunner. A collection in the Coeur d'Alene Laboratory records it from white pine cones.

Family Lymantriidae

Hemerocampa pseudotsugata McD. ((J.F.G.C.)). Sporadic outbreaks of the Douglas fir tussock moth have occurred in various parts of the northern Rocky Mountain region. Adults are common in infested areas during September.

ORDER DIPTERA

Family Ceratopogonidae

Forcipomyia aurea Mall. ((A.S.)).

F. simulata Walley ((A.S.)). These two flies are common beneath the bark of trees infested with the Douglas fir beetle. They are probably not predaceous. Adults emerged from bark in June.

Family Sciaridae

Sciara sp. ((C.T.G.)). Common beneath the bark of trees infested with the Douglas fir beetle. Adults emerged from bark in June.

Family Cecidomyiidae

Winnertzia sp. ((C.T.G.)). Larvae of this insect are gregarious in habit, and are common beneath the bark of trees infested with the Douglas fir beetle. They apparently feed on dead insects. Adults were reared from bark in July.

Family Rhagionidae

Xylophagus abdominalis Loew ((C.T.G.)). This insect is a facultative predator. Although found feeding on Douglas fir beetle larvae, it is more commonly found associated with wood borers. Adults were reared from bark in June, and females were collected, ovipositing during June and July.

Family Empididae

Tachypeza fenestrata (Say) ((C.T.G.)). Adults are common during June on the bark of trees infested with the Douglas fir beetle.

Family Dolichopodidae

Medeterus aldrichii Wheeler ((C.T.G.)). This fly is the second most important predator which attacks the Douglas fir beetle. Adults were common on the bark of newly infested trees during May and June. Larvae are found in these trees throughout the period while they are inhabited by the beetle.

Family Phoridae

Megaselia minor (Zett.) ((C.T.G.)).

M. sp. near minor ((C.T.G.)). Common in trees infested with the Douglas fir beetle. Adults were reared from bark in June.

Family Tachinidae

Actia pilipennis (Fall.) ((J.M.A.)).

Madremyia saundersii (Will.) ((J.M.A.)).

Nemorilla floralis (Fall.) ((J.M.A.)). Adults of these three tachinids emerged in August from chrysalids of the spruce budworm.

Family Lonchaeidae

Lonchaea corticis Taylor ((J.M.A.)). This fly is the most important predator which feeds on the Douglas fir beetle. Adults are abundant during August. Larvae are present in infested trees from August until July of the following year. The small red puparia are found during June and July.

ORDER COLEOPTERA

Family Silphidae

Agathidium revolvens Lec. ((W.S.F.)). This small black beetle probably feeds on refuse material beneath the bark of trees infested with the Douglas fir beetle. Adults were plentiful during May and June beneath the bark of trees which had been attacked the previous year.

Family Staphylinidae

Nudobius pugetanus Casey ((E.A.C.)).

Quedius marginalis Maklin ((E.A.C.)). These two rove beetles are facultative predators. Adults can be found during fall and spring beneath the bark of trees containing adults of the Douglas fir beetle.

Eumalus nigrella (Lec.) ((E.A.C.)).

Phloeonomus pusillus (Grav.) ((E.A.C.)).

Atheta sp. ((E.A.C.)). These three species of small rove beetles are among the first insects to appear beneath the bark of trees attacked by the Douglas fir beetle. Adults are common throughout the season.

Family Cucujidae

Cucujus clavipes var. *puniceus* Mann. The adults of this predator were common on the bark of trees being attacked by the Douglas fir beetle during May.

Family Cleridae

Thanasimus nigriventris Lec.

Enoclerus sphegeus (F.)

Thanasimus dubius (F.). Both the adults and larvae of these three insects are predacious. The adult clerids feed on the adult Douglas fir beetles as they attack the trees, and the clerid larvae feed on the immature stages of the beetle beneath the bark. *E. sphegeus* is the most abundant *T. dubius* next in abundance, and *E. lecontei* is rather rare in Douglas fir.

Family Elateridae

Elater nigrinus Hbst. ((W.S.F.)). Adults were collected during June on the bark of trees attacked by the Douglas fir beetle during May.

Family Buprestidae

Chrysobothris carinipennis Lec. ((H.E.B.)). Larvae were found beneath the bark during October.

C. pseudotsugae Van Dyke ((H.E.B.)). Females were ovipositing during July.

C. trinervia (Kirby) ((H.E.B.)). Females were ovipositing during July on a tree which had been wind-thrown during the previous winter.

Buprestis fasciata var. *langi* Mann. Females were ovipositing during July in the top of a wind-thrown tree.

B. maculativentris var. *rusticorum* Kirby ((W.S.F.)). Females were ovipositing in a wind-thrown tree during July.

Melanophila drummondi (Kirby). Males and females were abundant during July on trees attacked by the Douglas fir beetle in May.

Anthaxia aeneogaster Cast. ((H.E.B.)). Adults were reared during July from bark also infested with the Douglas fir beetle.

A. deleta Lec. ((W.S.F.)). Adults were reared from small branches during May and June.

Family Histeridae

Isomalus manicus (Csy.) ((H.S.B.)). Probably predacious on small insects beneath the bark. Adults are common during August in trees attacked by the Douglas fir beetle in May.

Family Colydiidae

Deretaphrus oregonensis Horn ((W.S.F.)). Adults were found beneath the bark of trees which had been killed by the Douglas fir beetle 2 years previously.

Family Ostomatidae

Temnochila virescens var. *chlorodea* (Mann.). This predacious beetle is not very common in Douglas fir. The larvae feed on the immature stages of the Douglas fir beetle. Adults were collected during August.

Family Cryptophagidae

Cryptophagus maximus Blake ((W.S.F.)). Adults were found during July beneath the bark of trees killed by the Douglas fir beetle during the previous season.

Salebius tarsalis Casey ((W.S.F.)). Adults were found during June beneath the bark of trees killed by the Douglas fir beetle during May of the previous year.

Atomaria sp. ((W.S.F.)). One adult was collected late in June in a tree attacked by the Douglas fir beetle during the early portion of the same month.

Family Nitidulidae

Epuraea truncatella Mann. ((E.A.C.)). Adults and larvae of this insect are common from July to June of the following season, beneath the bark of trees killed by the Douglas fir beetle during the current season.

Family Rhizophagidae

Rhizophagus dimidiatus Mann. ((W.S.F.)). This is a very common insect beneath the bark of trees killed by the Douglas fir beetle. Both adults and larvae can be found from July to the following June in trees attacked during the current season. Adults were observed in groups where conidia of blue stain fungi were numerous.

Family Ciidae

Enncarthron sp. ((W.S.F.)). Adults were collected in November from the sporophores of *Polyporus volvatus*.

Family Lathridiidae

Enicmus sp. ((W.S.F.)). Adults were reared during August from bark also infested with the Douglas fir beetle.

Family Tenebrionidae

Platydema oregonense Lec. (W.S.F.)). Adults were collected during June from sporophores.

Hypophloeus substriatus Lec. ((E.A.C.)).

H. sp. ((E.A.C.)). The adults and larvae of these two insects are probably predacious, feeding on the smaller insects beneath the bark of trees attacked by the Douglas fir beetle. Adults are common during June in trees killed during the previous season.

Family Melandryidae

Zilora nuda Prov. ((E.A.C.)). Adults were reared during June from bark infested with the Douglas fir beetle.

Serropalpus barbatus (Schl.) ((E.A.C.)). Adults were reared during July 1930 from the wood of trees killed by the Douglas fir beetle during May 1929. The larvae of this insect mine the sapwood and pupate in a pupal chamber approximately one-half inch beneath the surface of the wood.

Family Cerambycidae

Semanotus ligneus ((F.C.C.)). Larvae were collected in August from a tree attacked by the Douglas fir beetle during the preceding May.

Semanotus nicolas (White) ((W.S.F.)). Adults were reared from fuel wood during the winter.

Leptura oblitterata (Hald.).

Anoplodera aspera (Lec.).

A. canadensis (Oliv.).

Phymatodes dimidiatus (Kirby). The adults of these four cerambycids were collected during August, when females were ovipositing in trees attacked by the Douglas fir beetle during May of the current season.

Tetropium velutinum Lec. Adults were reared from bark during July.

Callidium antennatum var. *hesperum* Casey. Females were collected during May and June when they were ovipositing on a wind-thrown tree being attacked by the Douglas fir beetle.

Xylotrechus undulatus (Say). Adults were reared from wood during June. Females were also collected during June, ovipositing in trees recently attacked by the Douglas fir beetle.

Clytus planifrons (Lec.) ((W.S.F.)).

Monochamus notatus (Drury) ((W.S.F.)).

Acanthocinus obliquus (Lec.). Adults were collected during July and August on the bark of trees attacked by the Douglas fir beetle during the current season.

Holopleura marginata Lec. ((W.S.F.)). Adults were reared from Douglas fir branches during May.

Family Scolytidae

Scolytus ventralis Lec. ((M.W.B.)).

S. monticolae (Sw.) ((M.W.B.)).

S. unispinosus Lec. ((M.W.B.)).

S. tsugae (Sw.) ((M.W.B.)).

Hylastes nigrinus (Mann.) ((M.W.B.)).

Pseudohylesinus nebulosus (Lec.) ((M.W.B.)).

Orthotomicus caelatus (Eich.) ((M.W.B.)). This group of bark beetles attacks during June the tops and large branches of trees attacked by the Douglas fir beetle in May. *S. tsugae* has been found to kill small areas of Douglas fir

reproduction.

Polygraphus rufipennis (Kirby) ((M.W.B.)).

Phthorophloeus puberulus (Lec.) ((M.W.B.)). Attacks of these two bark beetles were found during July in limbs and small tops of trees attacked by the Douglas fir beetle in May.

Dendroctonus pseudotsugae Hopk. ((M.W.B.)). The Douglas fir beetle has become a serious pest in the northern Rocky Mountain region.

D. valens Lec. ((M.W.B.)). This insect attacks during June the bases of trees attacked by the Douglas fir beetle during May.

Pityophthorus pseudotsugae Sw. ((M.W.B.)).

Pityokteines elegans Sw. ((M.W.B.)). These two bark beetles attack the tops of trees at the time the trees are being attacked by the Douglas fir beetle in May.

Trypodendron bivittatum (Kirby) ((M.W.B.)). This ambrosia beetle attacks the wood at the bases of trees killed by the Douglas fir beetle. Attacks occur during May and June.

Dryocoetes affaber (Mann.) ((M.W.B.)).

D. pseudotsugae Sw. ((M.W.B.)). New attacks of these two insects were found in a wind-thrown tree during June.

Family Lucanidae

Ceruchus striatus Lec. Adults were collected from decaying logs.

ORDER HYMENOPTERA

Family Siricidae

Urocerus albicornis (F.) ((W.M.)).

U. californicus Nort. ((J.C.B.)).

Sirex juvencus race *cyaneus* F. ((G.A.S.)).

Xeris morrisoni (Cress.) ((G.A.S.)). Adults were collected during August. Females were ovipositing at this time in trees killed by the Douglas fir beetle during the preceding year.

Family Aulacidae

Aulacus editus Cress. ((R.A.C.)). Adults were reared from bark during June. This insect is probably a parasite of cerambycid and buprestid larvae.

A. abdominalis Cress. ((R.A.C.)). Females were collected during August when they were ovipositing on cerambycid and buprestid larvae.

Parmegischia sp. near *minnesotae* Bradl. ((R.A.C.)). Females were collected during August when they were ovipositing on cerambycid and buprestid larvae.

Family Ichneumonidae

Apechthis ontario (Cress.) ((R.A.C.)).

Itopectis montanus Cush. ((R.A.C.)). Adults of these two parasites were reared from cocoons of the Douglas fir tussock moth during August.

I. atrocoxalis (Cress.) ((R.A.C.)).

I. esuchus Cush. ((R.A.C.)). Adults of these two parasites emerged in August from chrysalids of the spruce budworm.

Ephialtes sanguineipes (Cress.) ((R.A.C.)). This parasite of the spruce budworm was reared from pupae during August.

Epiurus indagator (Cress.) ((R.A.C.)). Adults were collected during June in an infestation of the fir tussock moth.

E. atrocoxalis Ashm. ((R.A.C.)). Reared during August from spruce budworm material.

Idechthis sp. ((R.A.C.)). Adults were collected during July in an infestation of the fir tussock moth.

Lamachus sp. ((R.A.C.)). Adults were collected during June in an infestation of the fir tussock moth. Mr. Cushman states that this is a parasite of sawfly larvae.

Calliephialtes comstockii (Cress.) ((R.A.C.)).

C. new species ((R.A.C.)). Adults of these two parasites were reared from cones infested with the Douglas fir cone moth. Emergence occurred during August.

Campoplex n. sp. ((R.A.C.)). Adults were collected during August on bark of tree infested with the Douglas fir beetle.

Herpestomus hariolus (Cress.) ((R.A.C.)) This parasite of the spruce budworm was reared from pupae during August.

Exochus evetriae Roh. ((R.A.C.)). Emerged during May and June from cones infested with the Douglas fir cone moth.

Glypta fumiferanae (Vier.) ((R.A.C.)). Reared from larvae of the spruce budworm during August.

Xorides insularis (Cress.) ((R.A.C.)). Females of this species were found ovipositing on cerambycid and buprestid larvae during August.

Rhyssa persuasoria (L.) ((R.A.C.)).

R. lineolata (Kirby) ((R.A.C.)). These two ichneumonids are parasitic upon *Serropalpus* and horn-tail larvae. Adults emerged from larval tunnels during July.

Deuteroxorides occidentalis Cress. ((R.A.C.)). Parasitic upon buprestid larvae. Adults emerged during May.

Odontomerus tibialis Cush. ((R.A.C.)). Males were collected during June and females were found ovipositing during July on larvae of *Tetropium*.

Family Braconidae

Microbracon xanthonotus (Ashm.) ((R.A.C.)). Emerged during August from cocoons of the Douglas fir tussock moth.

M. rhyacioniae Mues. ((C.F.W.M.)). Emerged during May and June from cones infested with the Douglas fir cone moth.

Apanteles laspeyresiae Vier. ((C.F.W.M.)). Emerged during June from cones infested with the Douglas fir cone moth.

Atanycolus montivagus (Cress.) ((C.F.W.M.)).

A. n. sp. near montivagus (Cress.) ((C.F.W.M.)). Ovipositing during May and June in trees containing buprestid larvae.

A. sp. ((C.F.W.M.)).

Doryctes fartus (Prov.) ((C.F.W.M.)). Reared from white papery cocoons found in larval galleries of buprestids.

Coeloides brunneri Vier. ((C.F.W.M.)).

Coeloides dendroctoni Cush. ((R.A.C.)).

Coeloides scolyti Cush. ((R.A.C.)).

Coeloides n. sp. ((C.F.W.M.)). These four species are parasitic upon the Douglas fir beetle. *C. brunneri* is the most important parasite of this beetle and

is the most abundant of the four species listed.

Macrocentrus aegeriae Roh. ((C.F.W.M.)).

Helconidea occidentalis (Cress.) ((C.F.W.M.)).

Helcon yukonensis Ashm. ((C.F.W.M.)). Females of these three species were found ovipositing on cerambycid and buprestid larvae during August.

Microplitis sp. ((R.A.C.)). Probably a parasite of the Douglas fir tussock moth. Adults were collected during June in an infestation of the moth.

Spathius brunneri Vier. ((C.F.W.M.)). Parasite of *Scolytus*. Adults emerged in large numbers during June from bark infested with *Scolytus ventralis*.

Opius n. sp. ((R.A.C.)). Parasitic upon *Pseudohylesinus nebulosus*. Adults emerged from bark during June.

Family Callimomidae

Callimome sp. near *occidentale* Huber ((A.B.G.)). Emerged during May from cones infested with the Douglas fir cone moth.

Megastigmus spermatrophus Wachtl. Reared from seeds sent to J. M. Miller from Colorado. There is no record of this insect in the Coeur d'Alene Laboratory.

Monodontomerus dentipes (Boh.) ((A.B.G.)). Adults were collected during August in an infestation of the Douglas fir tussock moth.

Family Eurytomidae

Eurytoma pissodis Gir. ((A.B.G.)). Parasitic upon *Coeloides*. Adults emerged from *Coeloides hibernaculae* during August.

Family Pteromalidae

Amblymerus verditor (Nort.) ((A.B.G.)). Emerged during May from cones infested with the Douglas fir cone moth.

Cecidostiba dendroctoni Ashm. ((C.F.W.M.)).

Pachyceras eccoctogastri Ratz. ((C.F.W.M.)). These two pteromalids are parasitic upon larvae of the Douglas fir beetle. Adults are common late in July and early in August.

Dibrachys cavius (Walk.) ((A.B.G.)). Emerged during August from cocoons of the Douglas fir tussock moth.

Pachyneuron allograptae Ashm. ((A.B.G.)). Adults were collected during July in an infestation of the Douglas fir tussock moth.

Perniphora sp. ((A.B.G.)). Parasitic upon larvae of *Trypodendron bivittatum*. This parasite emerged in May from larval cradles of the Ambrosia beetle.

Family Eulophidae

Elachertus evetriae Gir. ((A.B.G.)). Emerged during May from cones infested with the Douglas fir cone moth.

Pleurotropis n. sp. ((A.B.G.)). Adults emerged during August from *Microbracon xanthonotus*.

Family Trichogrammatidae

Trichogramma minutum Riley ((A.B.G.)). Emerged during September from eggs of the spruce budworm.

Family Diapriidae

Golesus atricornis Ashm. ((C.F.W.M.)). Emerged during August from puparia of *Lonchaea corticis*.

Hemilexis californica Ashm. ((C.F.W.M.)). Emerged during July from larvae of *Forcipomyia*.

Family Scelionidae

Piestopleura n sp. ((A.B.G.)). Females were found ovipositing in cones infested with Douglas fir cone moth larvae.

Family Ibalidae

Ibalia ensiger Nort. ((L.H.W.)). One adult collected during June on bark of Douglas fir tree infested with the Douglas fir beetle.

Family Figitidae

Anacharis sp. ((L.H.W.)). Collected on branch tree infested with larvae of the Douglas fir tussock moth.

OBITUARY

FREDERICK COURTENAY GILLIATT

In the death of Frederick Courtenay Gilliatt, the Entomological Division of the Dominion Department of Agriculture lost a valuable officer, his immediate colleagues a personal friend, and the fruit industry a man who had laboured untiringly on some of its important problems.

During recent years he had not enjoyed good health, but shortly prior to his death he had appeared much improved and was himself looking forward to renewed and increasing activities, so that his passing on April 28, 1938, after a brief illness, came as a shock to his numerous friends.

Frederick Courtenay Gilliatt was born in Granville Centre, Annapolis County, Nova Scotia, in 1889. He was of a rather quiet and retiring disposition, but endowed with persistent industry, remarkable faculties for acute observation, and a penetrating humour displayed rarely except to his intimates. His interests were broad as evidenced by the large number of periodicals, more particularly the scientific journals, which it was his habit to peruse, and from which, coupled with his own keen judgment, and discrimination, he kept himself so well informed.

Shortly after his graduation from the Nova Scotia College of Agriculture in 1910, he was employed by the Nova Scotia Provincial Department of Agriculture, and from 1911 to 1915 he worked intermittently for the Provincial and Federal Departments, mostly in connection with the Brown Tail Moth and San Jose Scale. In 1915 he became permanently attached to the Dominion Entomological Laboratory at Annapolis Royal, Nova Scotia, where his rapidly developing natural instincts as a student and observer led to the important contributions which he made to the advancement of entomological knowledge. In 1919 he married Hortense V. B. Spurr, who together with his daughter Hortense Marie, aged 18, and son Shippy Courtenay, aged 16, were left to mourn his death.

Mr. Gilliatt was a member of several scientific and other organizations among which may be listed the American Association for the Advancement of Science, The Canadian Society of Technical Agriculturists, The Entomological Society of America, The Entomological Society of Ontario, The Professional Institute of Civil Servants of Canada, and the Nova Scotia Fruit Growers' Association.

He took an interest in many affairs of the community in which he lived.

For example, he was for a period, Chairman of the Finance Committee of the Town Council of Annapolis Royal. In spare time he frequently was to be found working in his garden or attending to his apiary. The culture of fruit was one of his special hobbies, and during the twelve years prior to his death, he had developed an extensive plantation of pears, peaches, cherries, and plums.

The following is a list of his more recent publications:

- "A Key to Certain Tortricid Larvae Occurring in Nova Scotia with Notes on Their Habits and Life-Histories"—Sci. Agr., Vol. X, No. 2, October 1929
 "The Bionomics of the Tortricid Moth, *Eulia Mariana* Fern"—Trans. Royal Soc. of Can., Vol. XXIII, Sec. V, 1929.
 "The Bionomics of the White Triangle Leaf Roller, *Cacoecia Persicana* Fitch"—Sci. Agr., Vol. X, No. 10, June 1930.
 "Four Years' Observation on the Eye-Spotted Budmoth *Spilonota Ocellana* D. & S. in Nova Scotia"—Sci. Agr., Vol. XII, No. 6, February 1932.
 "Notes on the Lesser Budmoth *Recurvaria Nanella* Hbn."—Sci. Agr. Vol. XIV, No. 9, May 1934.
 "A Mealy Bug *Phenacoccus Aceris* Sig., A New Apple Pest in Nova Scotia"—Rep. Ont. Ent. Soc., 1934.
 "A Mealy Bug *Phenacoccus Aceris* Sig., A New Apple Pest in Nova Scotia"—Can. Ent., August 1935.
 "European Red Mite, *Paratetranychus Pilosus* C. & F. in Nova Scotia"—Can. Jour. Research, D, 13: 1-17, 1935.
 "Some Predators of the European Red Mite *Paratetranychus Pilosus* C. & F. in Nova Scotia"—Can. Jour. Research, D, 13 : 19-38, 1935.
 "Observations on the Mealy Bug, *Phenacoccus Aceris*"—Can. Ent. June, 1936.
 "Life History and Habits of the Dusky Leaf Roller, *Amorbia Humerosana* Clem. in Nova Scotia"—Rep. Ont. Ent. Soc., 1936.
 "Natural Control of Gray Banded Leaf Roller *Eulia Mariana* Fern. in Nova Scotia Orchards"—Can. Ent., July 1937.
 "Some Records of Captures in Light Traps"—Rep. Ont. Ent. Soc. 1937.
 "The Cranberry Industry, Its Possibilities in Canada—A Section on Insects Affecting the Cranberry"—Dept. of Agr. Bul. No. 180-New Series.

In addition, he had just completed a manuscript, as yet unpublished, dealing with the life history of a previously undescribed hymenopterous parasite of the orchard mealy buy *Phenacoccus aceris* Sig.

A. KELSALL.

NEWS AND VIEWS

REPORT OF THE MONTREAL BRANCH ENTOMOLOGICAL SOCIETY OF ONTARIO.

The Sixty-fifth Annual Meeting of this Branch was held on May 13th, 1938, in the Lyman Entomological Room, McGill University, Montreal.

Eight meetings were held during the season—seven in the Lyman Entomological Room and one in the Entomological Laboratory of the University of Montreal with an average attendance of eight.

The following papers were read and talks given during 1938:—

Presidential Address—Genus <i>Lygus</i>	G. A. Moore
Notes—Season 1937	G. A. Moore
Obituary Notice Professor H. B. Fantham	H. A. U. Monro
Note on the finding of Mantids in Montreal	G. Chagnon
Review of H. L. Sweetman's "The Biological Control of Insects"	H. A. U. Monro
Review of Sanderson's "Animal Treasure"	G. A. Moore
Collecting in the West Indian Islands & British Guiana	E. Munroe
Corixidae or Water Boatmen	G. A. Moore
Collecting in Canada's Eastern Arctic	W. J. Brown
Relations between Insects and Flowers	Dr. R. D. Gibbs
The Locust Problem	Rev. Father O. Fournier

The following were elected officers for the coming year:—

President, G. A. Moore; Vice-President, Rev. Father O. Fournier; Secretary-Treasurer, H. A. U. Monro.

Mailed Saturday, October 8th, 1938.

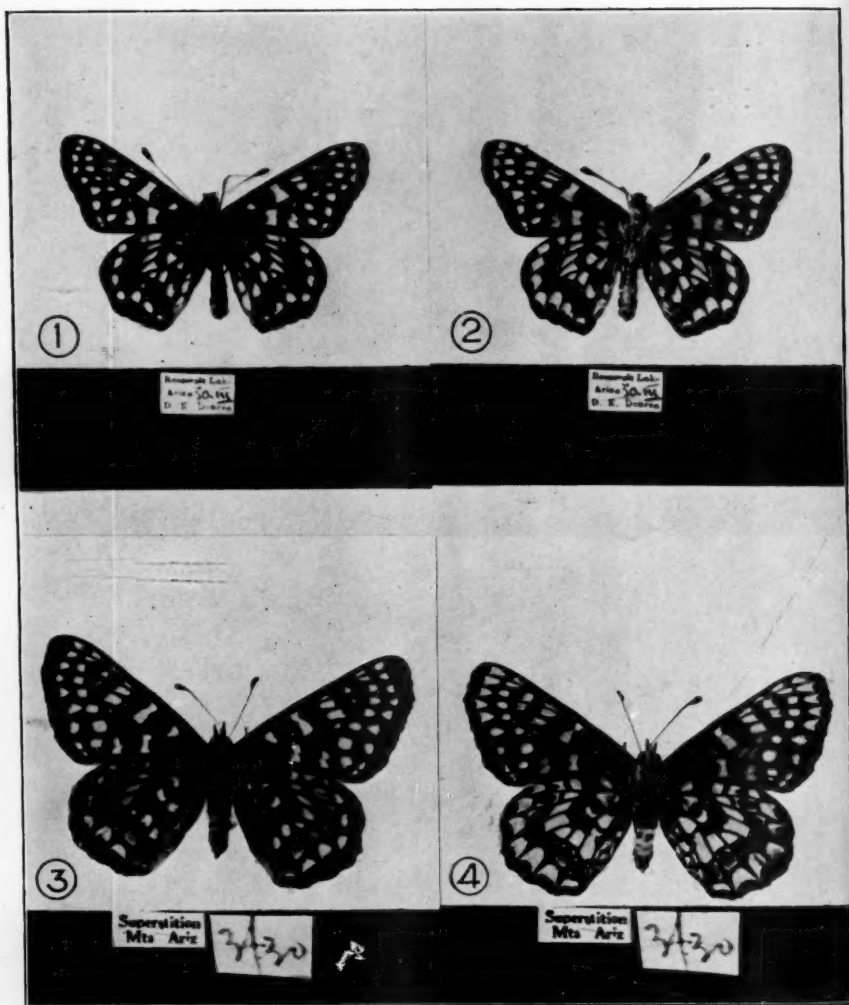


Fig. 1. *E. chalcadona klotsi* n. ssp. holotype ♂, upperside. Fig. 2. *E. chalcadona klotsi* n. ssp. holotype ♂, underside. Fig. 3. *E. chalcadona klotsi* n. ssp. allotype ♀, upperside. Fig. 4. *E. chalcadona klotsi* n. ssp. allotype ♀, underside.

